IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ADVANCED CODING TECHNOLOGIES LLC,	§	Case No.
	§	**JURY TRIAL DEMANDED**
Plaintiff,	§	
v.	§	
APPLE INC.,	§	
Defendant.	§	

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Advanced Coding Technologies LLC ("ACT" or "Plaintiff"), for its Complaint against Defendant Apple Inc. (collectively "Apple" or "Defendant") for patent infringement under 35 U.S.C. § 271, alleges as follows:

THE PARTIES

1. ACT is a limited liability company organized and existing under the laws of the State of Texas, with its principal place of business located at 104 East Houston Street, Suite 140, Marshall, Texas 75670.

2. Defendant Apple is a corporation organized and existing under the laws of California. Apple is one of the leading mobile phone, handset, and PC sellers in the United States and the world. Apple sells its products directly to consumers at physical Best Buy locations. There are multiple Best Buy locations in this District where Apple products are sold directly to customers, including at least: 823 North Creek Drive, Sherman, Texas 75092 (Grayson County), 2800 North Central Expressway, Plano, Texas 75074 (Collin County); 1751 North Central Expressway, Suite C, McKinney, Texas 75070 (Collin County); 3333 Preston Road, Suite 200, Frisco, Texas 75034

(Denton County); 5299 Eldorado Parkway, Frisco, Texas 75033 (Denton County); 1800 South Loop 288, Suite 102 Building 1; Denton, Texas 76205 (Denton County); 6060 Long Prairie Road, Suite 500, Flower Mound, Texas 75028 (Denton County); 2601 South Stemmons Freeway, Suite 300, Lewisville, Texas 75067 (Denton County); 5885 East Freeway, Beaumont, Texas 77706 (Jefferson County); 8725 Memorial Boulevard, Port Arthur, Texas 77640 (Jefferson County); 869 NE Mall Boulevard, Hurst, Texas 76053 (Shelby County); 422 West Loop 281, Suite 100, Longview, Texas 75605 (Gregg County); 4210 Saint Michael Drive, Texarkana, Texas 75503 (Bowie County); 5514 South Broadway Avenue, Tyler, Texas 75703 (Smith County). https://stores.bestbuy.com/tx/sherman/823-n-creek-dr-1023.html#shop;

https://stores.bestbuy.com/tx/plano/2800-n-central-expy-202.html;

https://stores.bestbuy.com/tx/frisco/3333-preston-rd-180.html;

https://stores.bestbuy.com/tx/frisco/5299-eldorado-pkwy-1773.html;

https://stores.bestbuy.com/tx/beaumont/5885-eastex-fwy-238.html;

https://stores.bestbuy.com/tx/denton/1800-s-loop-288-827.html;

https://stores.bestbuy.com/tx/flower-mound/6060-long-prairie-rd-1038.html;

https://stores.bestbuy.com/tx/lewisville/2601-s-stemmons-fwy-258.html;

https://stores.bestbuy.com/tx/longview/422-w-loop-281-594.html;

https://stores.bestbuy.com/tx/mckinney/1751-n-central-expy-196.html;

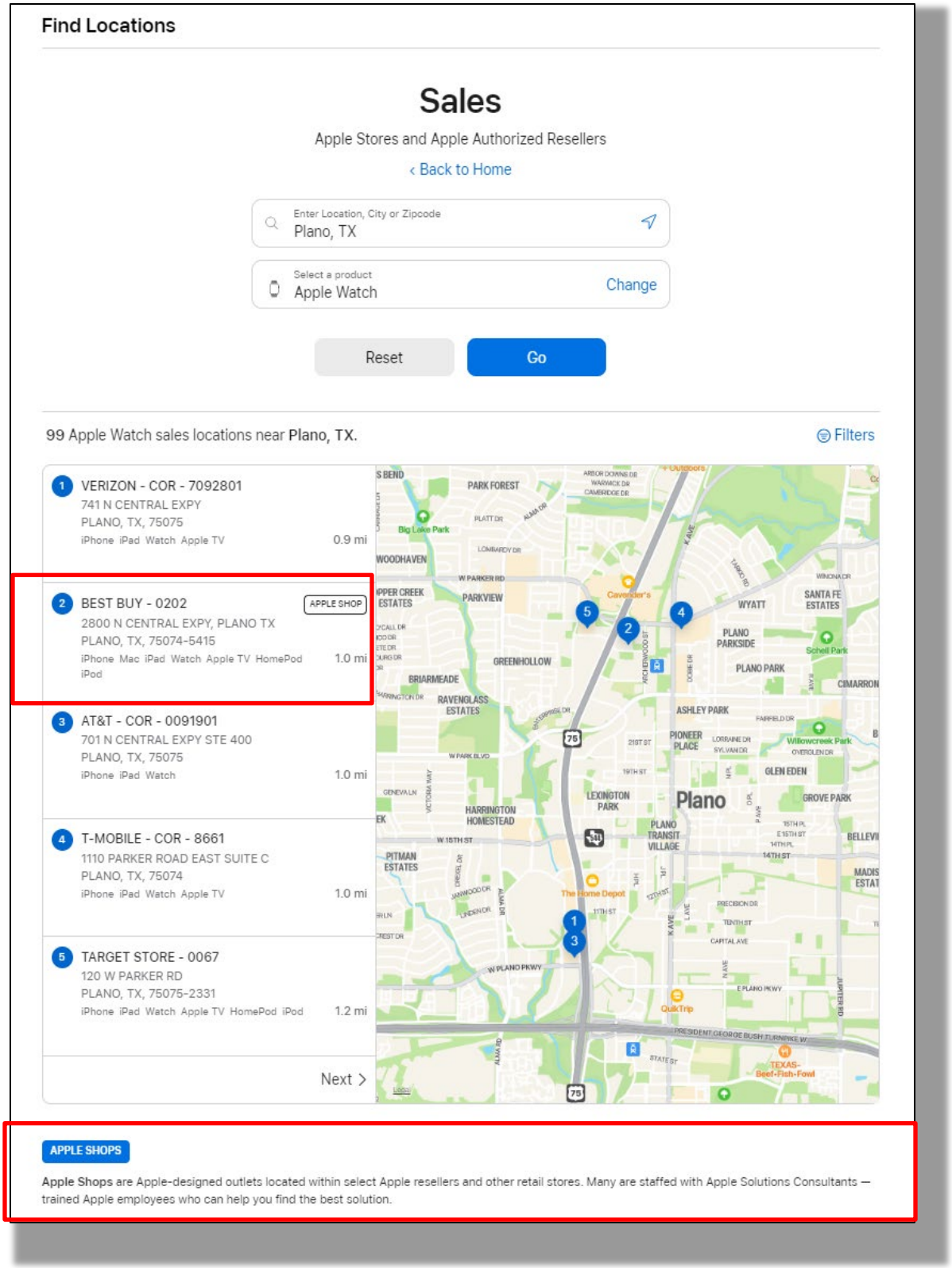
https://stores.bestbuy.com/tx/port-arthur/8725-memorial-blvd-1545.html;

https://stores.bestbuy.com/tx/texarkana/4210-saint-michael-dr-605.html;

https://stores.bestbuy.com/tx/tyler/5514-s-broadway-ave-246.html

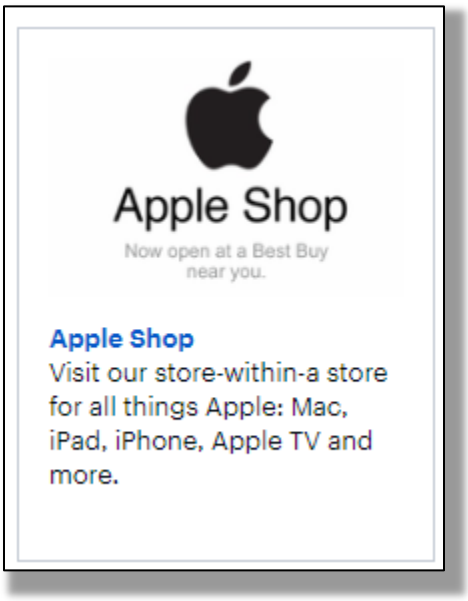
3. Further, certain Best Buy locations within this District contain Apple Shops. According to Apple's website, "Apple Shops are Apple-designed outlets located within select

Apple resellers and other retail stores. Many are staffed with Apple Solutions Consultants — trained Apple employees who can help you find the best solution." *See* https://locate.apple.com/sales?pt=6&lat=33.021827697753906&lon=-96.69925689697266&address=Plano%2C+TX. Apple advertises on its website that the Best Buy located at 2800 North Central Expressway, Plano, Texas 75074-5415 (Collin County), contains an Apple Shop. *See* https://locate.apple.com/sales?pt=6&lat=33.021827697753906&lon=-96.69925689697266&address=Plano%2C+TX. Apple further advertises on its website other Best Buy locations within this District that contain Apple Shops, including the store located at 190 East Stacy Road, Allen, Texas 75002-8734 (Collin County). *See* https://locate.apple.com/sales?pt=6&lat=33.021827697753906&lon=-96.69925689697266&address=Plano%2C+TX.


Find Locations
Sales
Apple Stores and Apple Authorized Resellers
‹ Back to Home
Enter Location, City or Zipcode
Plano, TX
Select a product
Apple Watch
Change
Reset
Go
99 Apple Watch sales locations near Plano, TX.
Filters
1 VERIZON - COR - 7092801
741 N CENTRAL EXPY
PLANO, TX, 75075
iPhone iPad Watch Apple TV
0.9 mi
2 BEST BUY - 0202
APPLE SHOP
2800 N CENTRAL EXPY, PLANO TX
PLANO, TX, 75074-5415
iPhone Mac iPad Watch Apple TV HomePod iPod
1.0 mi
3 AT&T - COR - 0091901
701 N CENTRAL EXPY STE 400
PLANO, TX, 75075
iPhone iPad Watch
1.0 mi
4 T-MOBILE - COR - 8661
1110 PARKER ROAD EAST SUITE C
PLANO, TX, 75074
iPhone iPad Watch Apple TV
1.0 mi
5 TARGET STORE - 0067
120 W PARKER RD
PLANO, TX, 75075-2331
iPhone iPad Watch Apple TV HomePod iPod
1.2 mi
Next >
Plano
APPLE SHOPS
Apple Shops are Apple-designed outlets located within select Apple resellers and other retail stores. Many are staffed with Apple Solutions Consultants — trained Apple employees who can help you find the best solution.

https://locate.apple.com/sales?pt=6&lat=33.021827697753906&lon=-96.69925689697266&address=Plano%2C+TX

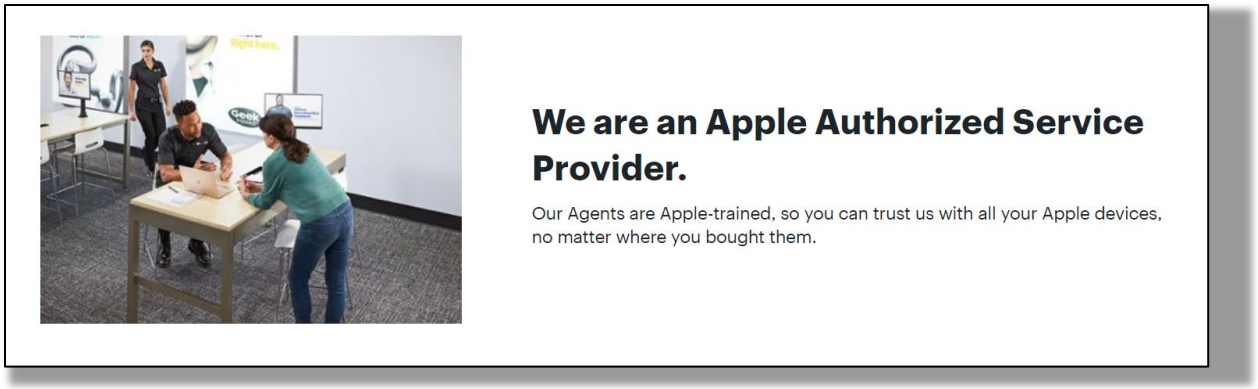
4. By way of further example, Best Buy also advertises on its website that the location in Plano, Texas, is an Apple Shop.



https://stores.bestbuy.com/tx/plano/2800-n-central-expy-202.html

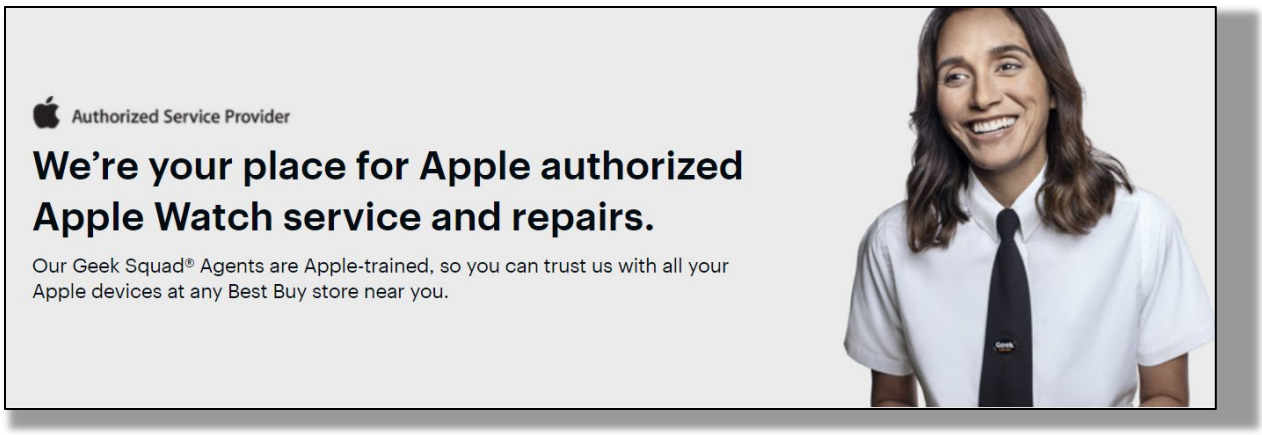
5. Best Buy also advertises on its website that an Apple Shop is located at the store in Allen, Texas. https://stores.bestbuy.com/tx/allen/190-e-stacy-rd-1780.html

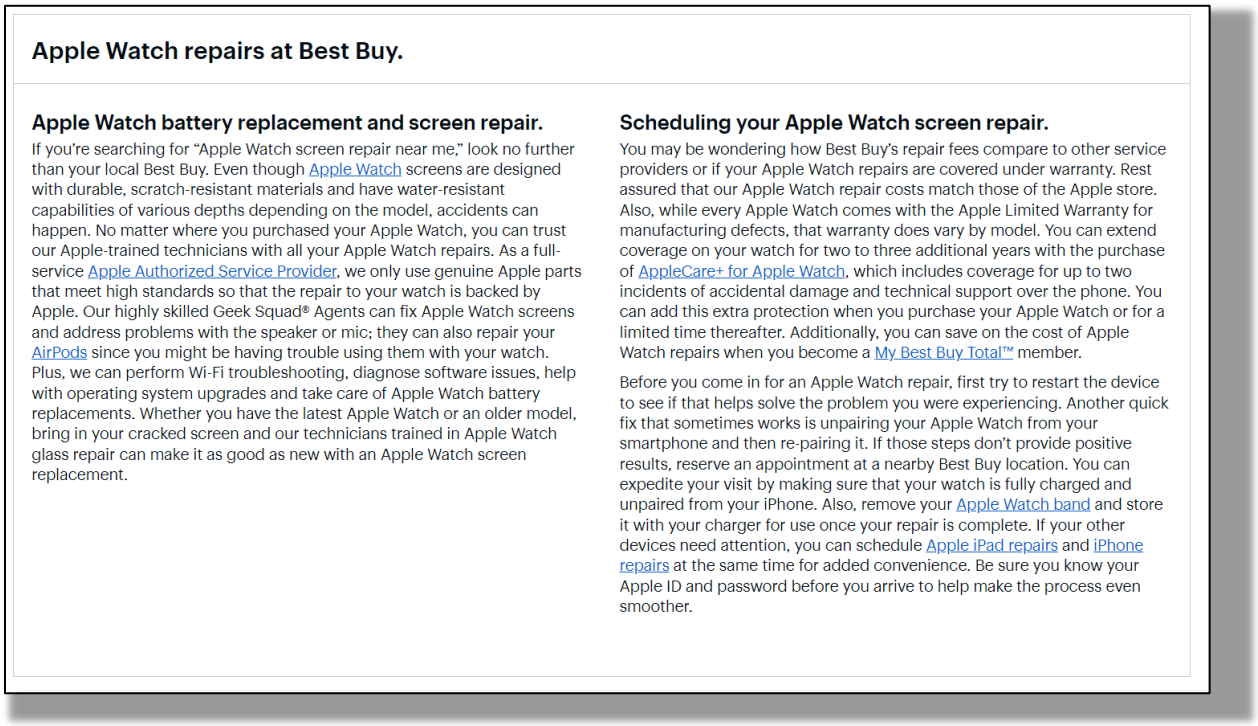
6. Further, certain Best Buy locations, including those located in this District, are "Apple Authorized Service Providers" and the "Geek Squad Agents" at Best Buy locations are "Apple-trained and use genuine Apple parts on every repair." https://www.bestbuy.com/site/services/apple-service repair/pcmcat1554741516170.c?id=pcmcat1554741516170



https://www.bestbuy.com/site/apple-service-repair/apple-watch-service-repair/pcmcat1554832617549.c?id=pcmcat1554832617549

https://www.bestbuy.com/site/services/apple-service-repair/pcmcat1554741516170.c?id=pcmcat1554741516170



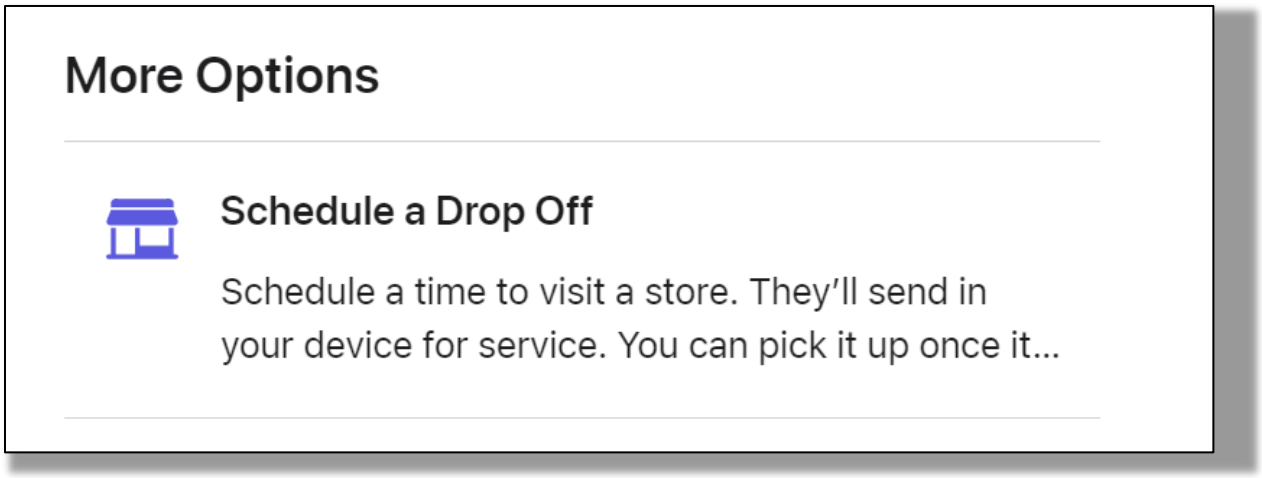


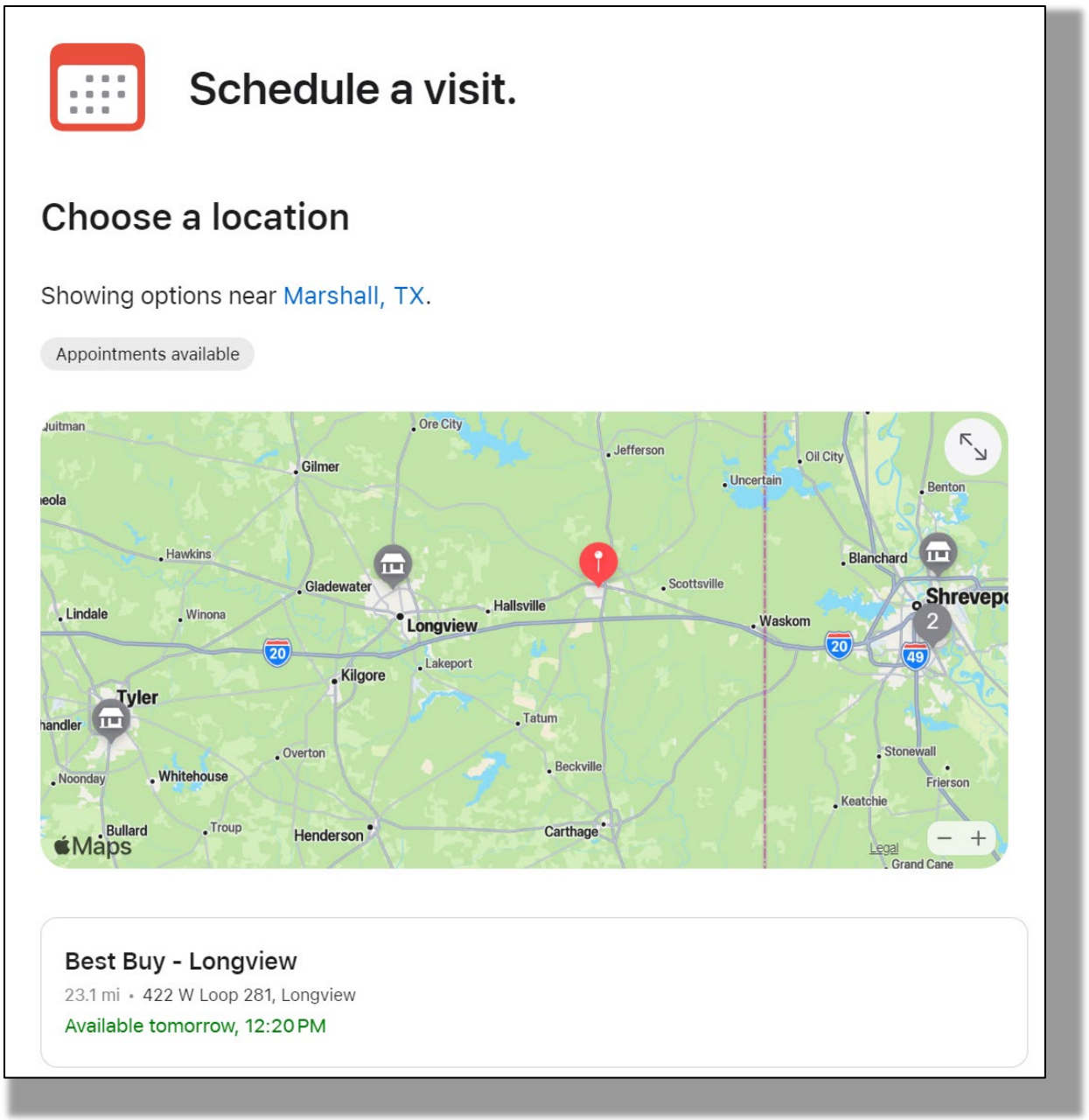
https://www.bestbuy.com/site/apple-service-repair/apple-watch-service-repair/pcmcat1554832617549.c?id=pcmcat1554832617549

7. Upon information and belief, Defendant employs individuals in this Judicial District involved in the technology, sales, and marketing of its products.

8. Apple touted the expansion of its "Apple authorized service network" at "nearly 1,000 Best Buy stores across the U.S. now providing expert service and repairs for Apple products." https://www.apple.com/newsroom/2019/06/apple-partners-with-best-buy-for-

expanded-repair-service/. Further, Apple states that "Apple-certified repairs at an Apple store or an authorized service provider are performed by trained experts who use genuine Apple parts. Every repair is backed by Apple." https://www.apple.com/newsroom/2019/06/apple-partners-with-best-buy-for-expanded-repair-service/. When a customer or user seeks to schedule a repair from Apple's website, Apple directs its users to Best Buy locations within this District.





https://getsupport.apple.com/solutions

9. Apple advertises on its website these Best Buy locations as Apple Authorized Service Providers as certified "so you get the same professionalism and quality of repair you'd expect from Apple." https://getsupport.apple.com/solutions/schedule-repair/providers

10. Apple has admitted that, "[w]hile at Best Buy, Apple's employees provide information about Apple's products to prospective customers" and that "[m]any are staffed with Apple Solutions Consultants – trained Apple employees who can help you find the best solution."). *Slyde Analytics LLC, v. Apple Inc.*, Case No. 2:24-cv-00331-RWS-RSP, Dkt. 21, 11 (citations omitted). Upon information and belief, Defendant employs individuals in this Judicial District involved in the technology, sales, and marketing of its products.

JURISDICTION

11. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. §§ 1, *et seq*. This Court has jurisdiction over this action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

12. This Court has specific and personal jurisdiction over Defendant consistent with the requirements of the Due Process Clause of the United States Constitution and the Texas Long Arm Statute. Upon information and belief, Defendant has sufficient minimum contacts with the forum because Defendant transacts substantial business in the State of Texas and in this Judicial District. Further, Defendant has, directly or through subsidiaries or intermediaries, committed and continues to commit acts of patent infringement in the State of Texas and in this Judicial District as alleged in this Complaint, alleged more particularly below.

13. Venue is proper in this Judicial District as to Defendant pursuant to 28 U.S.C. §§ 1400(b) and 1391(b) and (c) because Defendant is subject to personal jurisdiction in this Judicial District, has committed acts of patent infringement in this Judicial District, and has a regular and established place of business in this Judicial District. Defendant, through its own acts, makes, uses, sells, and/or offers to sell infringing products within this Judicial District, regularly

does and solicits business in this Judicial District, and has the requisite minimum contacts with the Judicial District such that this venue is a fair and reasonable one.

PATENTS-IN-SUIT

14. On January 3, 2012, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,090,025 (the "'025 Patent") entitled "Moving-Picture Coding Apparatus, Method and Program, and Moving-Picture Decoding Apparatus, Method and Program." On October 4, 2022, the United States Patent and Trademark Office duly and legally issued a Certificate of Correction to the '025 Patent. A true and correct copy of the '025 Patent is attached hereto as Exhibit A.

15. On May 29, 2018, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 9,986,303 (the "'303 Patent") entitled "Video Image Coding Data Transmitter, Video Image Coding Data Transmission Method, Video Image Coding Data Receiver, and Video Image Coding Data Transmission and Reception System." A true and correct copy of the '303 Patent is attached hereto as Exhibit B.

16. On February 26, 2019, the United States Patent and Trademark Office duly and legally issued U. S. Patent No. 10,218,995 (the "'995 Patent") entitled "Moving Picture Encoding System, Moving Picture Encoding Method, Moving Picture Encoding Program, Moving Picture Decoding System, Moving Picture Decoding Method, Moving Picture Decoding Program, Moving Picture Reencoding System, Moving Picture Reencoding Method, Moving Picture Reencoding Program." A true and correct copy of the '995 Patent is attached hereto as Exhibit C.

17. ACT is the sole and exclusive owner of all right, title, and interest in the '025 Patent, the '303 Patent, and the '995 Patent (collectively, the "Patents-in-Suit") and holds the exclusive right to take all actions necessary to enforce its rights to the Patents-in-Suit, including the filing of

this patent infringement lawsuit. ACT also has the right to recover all damages for past, present, and future infringement of the Patents-in-Suit.

FACTUAL ALLEGATIONS

18. The Patents-in-Suit generally relate to systems and methods for coding and decoding data efficiently.

19. The ’025 Patent generally relates to efficient methods of video encoding and decoding using motion compensation. The technology described in the ’025 Patent was developed by Satoru Sakazume of Victor Company of Japan, Ltd.

20. The ’303 Patent generally relates to technology that allows for the efficient transmission and reception of two different resolutions of video data. The technology described in the ’303 Patent was developed by Hideki Takehara and Motoharu Ueda of JVC Kenwood Corporation.

21. The ’995 Patent generally relates to hierarchical encoding that implements a process for super-resolution enlargement of video signals. The technology described in the ’995 Patent was developed by Satoru Sakazume of JVC Kenwood Corporation.

22. Defendant has infringed and continue to infringe one or more of the Patents-in-Suit by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import products, including Defendant’s iPhones, iPads, Macs, and Defendant’s software and services, such as Safari, QuickTime, and Apple TV+, and chipsets thereof, that implement the AV1 technology claimed by the Patents-in-Suit, as described below.

23. Defendant has been on actual notice of the ’025 Patent and Defendant’s infringement thereof at least as of February 24, 2012, when it was cited during prosecution of

Defendant's United States Provisional Patent Application No. 61/603,047, entitled "Pixel Patch Collection for Prediction in Video Coding System."

24. In January 2018, Defendant joined the Alliance for Open Media ("AOM"), a non-profit industry consortium headquartered in Wakefield, Massachusetts, and formed to develop open, royalty-free technology for multimedia delivery. https://bitmovin.com/apple-joins-av1-codec-consortium; https://aomedia.org/about/. AOM is the creator of AV1. https://aomedia.org/about/.

25. ACT has at all times complied with the marking provisions of 35 U.S.C. § 287 with respect to the Asserted Patents.

COUNT I
(Infringement of the '025 Patent)

26. Paragraphs 1 through 25 are incorporated by reference as if fully set forth herein.

27. ACT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '025 Patent.

28. Defendant has and continues to directly infringe the '025 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '025 Patent. Such products include at least all iPhones and iPads running iOS 15 or later (e.g., iPhone 15, iPhone Pro, iPad Pro (11-inch, M4, 2024), iPad Pro (13-inch, M4, 2024)), all Macs running macOS Big Sur or later (e.g., iMac (24-inch, 2023), MacBook Pro (14-inch, Nov 2023), MacBook Pro (16-inch, Nov 2023), MacBook Air (13-inch, M3, 2024), and MacBook Air (15-inch, M3, 2024)), and all Apple TVs running tvOS 14 or later, in addition to Apple software and services, such as Safari, QuickTime, and Apple TV+ (the '025 Accused Products) (https://www.coconut.co/articles/ultimate-guide-apples-av1-support-

2023; https://bitmovin.com/av1-playback-support), which practice a moving-picture decoding method comprising the steps of: demultiplexing coded data from an input signal based on a specific syntax structure, the input signal being obtained by multiplexing a coded bitstream obtained by predictive coding, border motion-vector data and post-quantization data obtained by quantization in the predictive coding, the coded bitstream obtained by producing and encoding a residual picture that is a residual signal between a picture to be coded that is an input moving-picture video signal to be subjected to coding and a predictive picture produced from a reference picture that is a local decoded video signal for each of a plurality of rectangular zones, each composed of a specific number of pixels, into which a video area of the moving-picture video signal is divided, obtaining a boundary condition of each of a plurality of borders between the rectangular zones and another plurality of rectangular zones adjacent to the rectangular zones, finding a border, of the reference picture, having a boundary condition that matches the boundary condition, by motion-vector search in the reference picture, and generating the border motion-vector data that is data on a motion vector from a border of the rectangular zone in the picture to be coded to the border of the reference picture thus found, defining a boundary condition of a border that corresponds to the border motion-vector data, from the reference picture based on the border motion-vector data, and generating an estimated video signal in each rectangular zone in the picture to be coded, that satisfies Poisson's Equation, thus producing the predictive picture; performing entropy decoding to the data thus demultiplexed to generate, at least, the post-quantization data, the border motion-vector data and parameter data required for constructing a specific syntax structure; performing inverse-quantization to the post-quantization data to generate post-quantization orthogonal transform coefficients data; performing inverse-orthogonal transform to the post-quantization orthogonal transform coefficients data to produce a decoded residual picture of one video area;

defining a boundary condition of a border that corresponds to the border motion-vector data, from the reference picture based on the border motion-vector data, and generate an estimated video signal in each rectangular zone in the picture to be coded, that satisfies Poisson's Equation, thus producing a first predictive picture; combining the first predictive picture and the decoded residual picture to generate a decoded moving-picture signal; and storing the decoded moving-picture signal for at least one picture as a reference picture.

29. For example, Defendant has and continues to directly infringe at least claim 10 of the '025 Patent by making, using, offering to sell, selling, and/or importing into the United States iPhones, iPads, Macs, and Apple software and services, such as Safari, QuickTime, and Apple TV+, and chipsets thereof, that are compliant with the AV1 and/or SVT-AV1 Standards, such as the '025 Accused Products.

30. The '025 Accused Products demultiplex coded data from an input signal based on a specific syntax structure, the input signal being obtained by predictive coding, border motion-vector data, and post-quantization data obtained by quantization in the predictive coding:

Supported video codecs (AU7/BEA Series)

File format	Container	Video codecs	Resolution	Frame rate (fps)	Bitrate (Mbps)	Audio codecs
*.avi *.mkv *.asf *.wmv *.mp4 *.mov *.3gp *.vro *.mpg *.mpeg *.ts *.tp *.trp *.flv *.vob *.svi *.m2ts *.mts	AVI MKV ASF MP4 3GP MOV FLV VRO VOB PS TS SVAF	H.264 BP/MP/HP	3840 x 2160	3840 x 2160: 30 1920 x 1080: 60	50	Dolby Digital LPCM ADPCM(IMA, MS) AAC HE-AAC WMA Dolby Digital+ MPEG(MP3) AC-4 G.711(A-Law, μ-Law) OPUS
		HEVC (H.265 - Main, Main10)		60	50	
		Motion JPEG	1920 x 1080	60	20	
		MVC				
		MPEG4 SP/ASP				
		Window Media Video v9 (VC1)				
		MPEG2				
		MPEG1				
		Microsoft MPEG-4 v1, v2, v3		30		
		Window Media Video v7 (WMV1), v8 (WMV2)				
		H.263 Sorrenson				
		VP6				
		AV1	3840 x 2160	60	40	
*.webm	WebM	VP8	1920 x 1080	60	20	Vorbis
		VP9 (Profile 0, profile 2 supported)	3840 x 2160	60	50	
		AV1	3840 x 2160	60	40	
*.rmvb	RMVB	RV8/9/10 (RV30/40)	1920 x 1080	60	20	RealAudio 6

Source: https://downloadcenter.Apple.com/content/UM/202109/20210930143505633/OSNDVBADA-7.1.0_EM_OSCAR_ASIA_ENG_210709.0.pdf

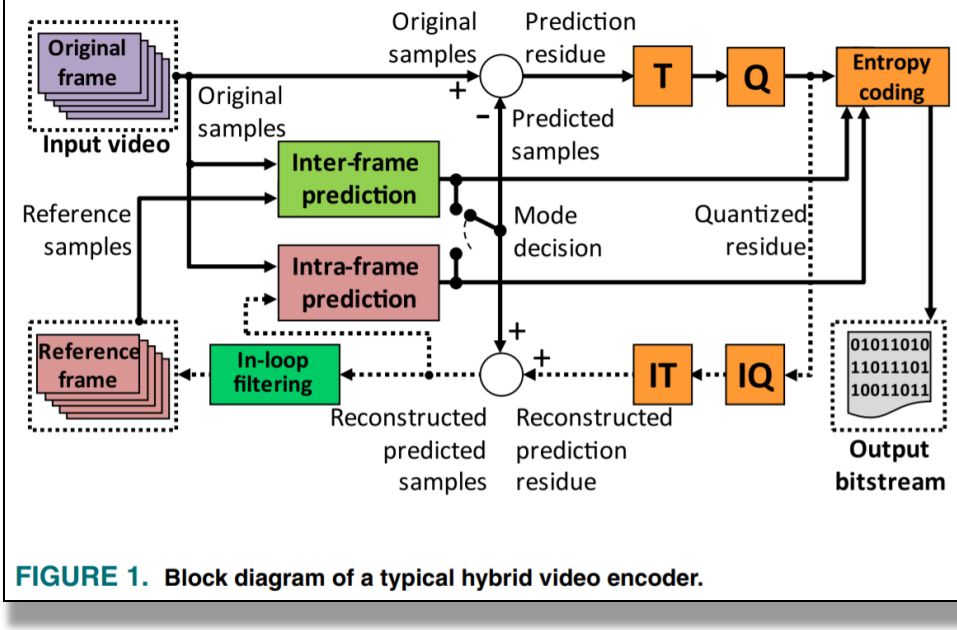


FIGURE 1. **Block diagram of a typical hybrid video encoder.**

Source: https://ieeexplore.ieee.org/ielx7/8784029/9314963/09536216.pdf

31. The coded bitstream in the '025 Accused Products is obtained by producing and encoding a residual picture that is a residual signal between a picture to be coded that is an input moving-picture video signal to be subjected to coding and a predictive picture produced from a reference picture that is a local decoded video signal for each of a plurality of rectangular zones, each composed of a specific number of pixels, into which a video area of the moving-picture video signal is divided:

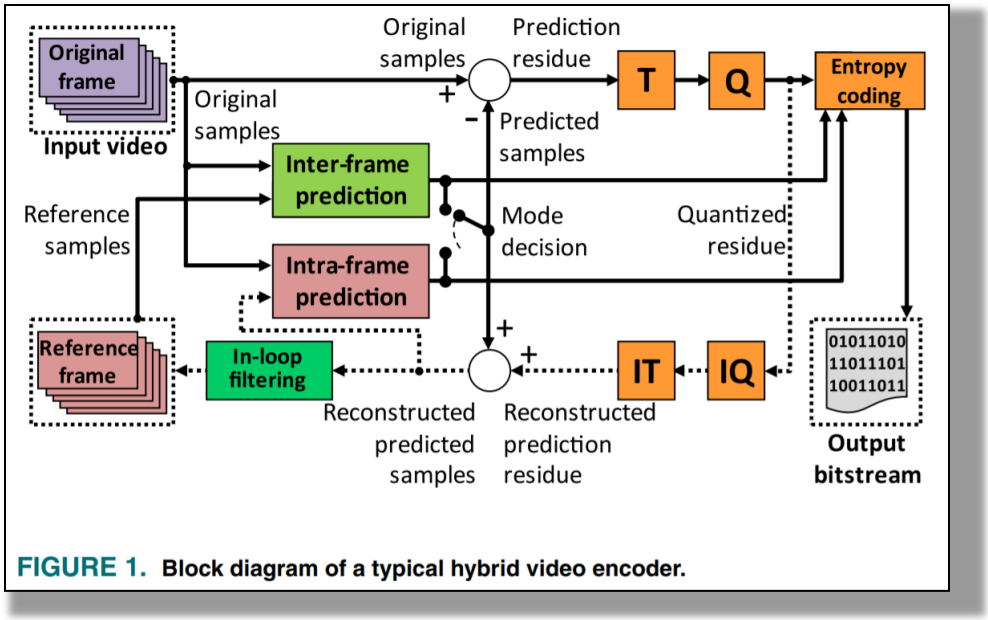


FIGURE 1. Block diagram of a typical hybrid video encoder.

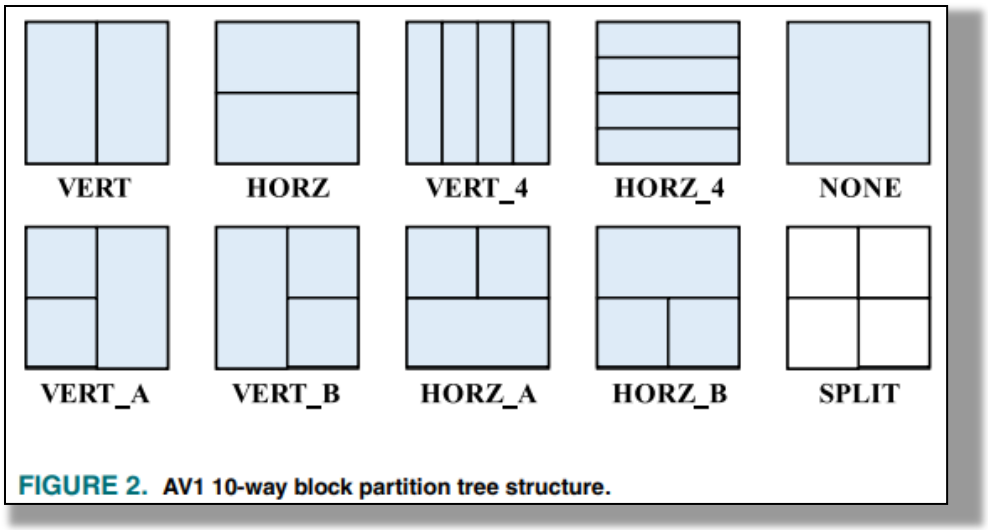
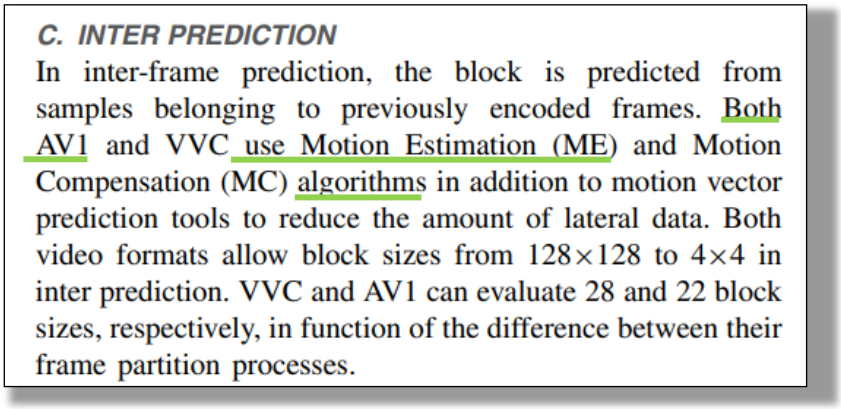


FIGURE 2. AV1 10-way block partition tree structure.

Source: https://ieeexplore.ieee.org/ielx7/8784029/9314963/09536216.pdf

32. The ’025 Accused Products obtain a boundary condition of each of a plurality of borders between the rectangular zones and another plurality of rectangular zones adjacent to the rectangular zones, find a border, of the reference picture, having a boundary condition that matches the boundary condition, by motion-vector search in the reference picture, and generate the border motion-vector data that is data on a motion vector from a border of the rectangular zone in the picture to be coded to the border of the reference picture thus found, by using the motion estimation

process for a block and locating the pixel values at the border between the current block and the neighboring block. Border motion-vector data is generated when a boundary condition in the reference frame matches the boundary condition in the current frame, and the block motion estimation algorithm uses a comparison of these boundary conditions to generate motion vectors:



C. INTER PREDICTION

In inter-frame prediction, the block is predicted from samples belonging to previously encoded frames. Both AV1 and VVC use Motion Estimation (ME) and Motion Compensation (MC) algorithms in addition to motion vector prediction tools to reduce the amount of lateral data. Both video formats allow block sizes from 128×128 to 4×4 in inter prediction. VVC and AV1 can evaluate 28 and 22 block sizes, respectively, in function of the difference between their frame partition processes.

Source: https://ieeexplore.ieee.org/document/8296419

33. The ’025 Accused Products define a boundary condition of a border that corresponds to the border motion-vector data, from the reference picture based on the border motion-vector data and generate an estimated video signal in each rectangular zone in the picture to be coded, that satisfies Poisson’s Equation, thus producing the predictive picture. For example, the estimated signal generation process in AV1 and/or SVT-AV1 satisfies Poisson’s Equation via the use of smoothing algorithms in Overlapped Block Motion Compensation (“OMBC”). The process involves finding predicted pixels of a block in steady state (that minimizes the residual). The estimated video signal is used to produce a predictive picture (*e.g.*, predictive sample):

(see Fig.2(b) for a 32-tap example) and formulated as

$$w_K(k) = \frac{1}{2}sin(\frac{\pi}{2K}(k+\frac{1}{2})) + \frac{1}{2}, k = 0, 1, ..., K-1 \quad (1)$$

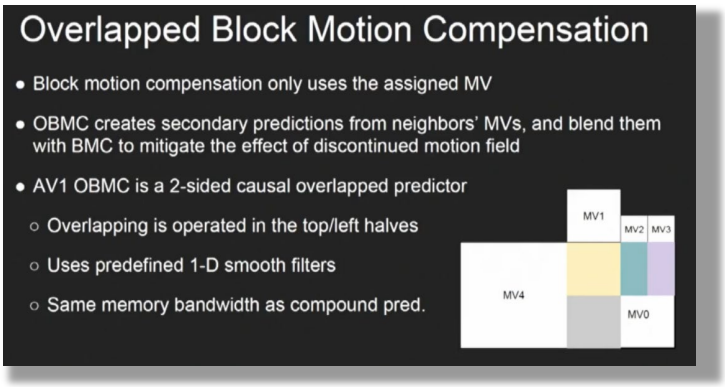
is applied to every column (see Fig.2(a)) of the overlapping region, and updates $p_{obmc}(x, y)$ as

$$w_{\frac{N}{2}}(y)p_{obmc}(x, y) + (1 - w_{\frac{N}{2}}(y))p_i(x, y). \quad (2)$$

This filter approximately averages the predictions at the common edge, and gradually reduces the influence of the new prediction p_i until it vanishes at the mid-line of the current block, because the conventional block matching p_0 often works best for pixels in the center. Then we move on to the second stage to exploit predictors of the left neighbors. Likewise, 1-D filtering will be performed on top of the $p_{obmc}(x, y)$ updated after the first phase: (1) the overlapping region for each left neighbors will be on the right side of the common edge, e.g. the shaded area for p_4 in Fig.1(b); (2) we apply the 1-D filter in the horizontal direction, i.e.

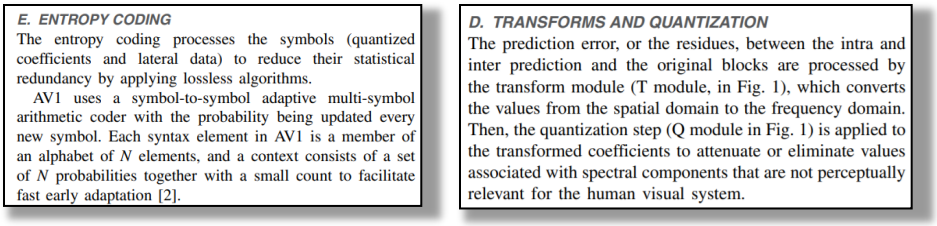
$$p_{obmc}(x, y) := w_{\frac{M}{2}}(x)p_{obmc}(x, y) + (1 - w_{\frac{M}{2}}(x))p_i(x, y). \quad (3)$$

Source: https://ieeexplore.ieee.org/document/8296419



Source: https://wenxiaoming.github.io/2019/03/02/The-overview-of-AV1-coding/

34. The '025 Accused Products perform entropy decoding to the data thus demultiplexed to generate, at least, the post-quantization data, the border motion-vector data and parameter data required for constructing a specific syntax structure:



E. ENTROPY CODING

The entropy coding processes the symbols (quantized coefficients and lateral data) to reduce their statistical redundancy by applying lossless algorithms.

AV1 uses a symbol-to-symbol adaptive multi-symbol arithmetic coder with the probability being updated every new symbol. Each syntax element in AV1 is a member of an alphabet of N elements, and a context consists of a set of N probabilities together with a small count to facilitate fast early adaptation [2].

D. TRANSFORMS AND QUANTIZATION

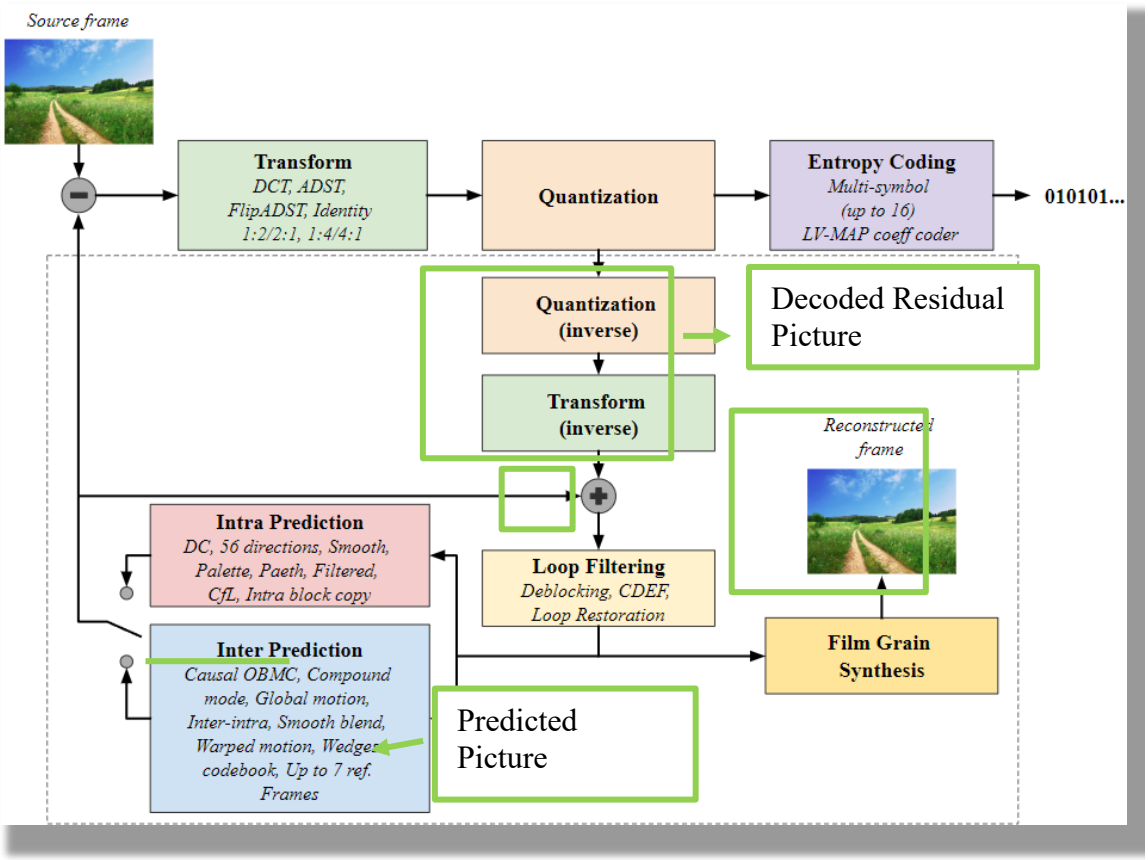
The prediction error, or the residues, between the intra and inter prediction and the original blocks are processed by the transform module (T module, in Fig. 1), which converts the values from the spatial domain to the frequency domain. Then, the quantization step (Q module in Fig. 1) is applied to the transformed coefficients to attenuate or eliminate values associated with spectral components that are not perceptually relevant for the human visual system.

Source: https://ieeexplore.ieee.org/ielx7/8784029/9314963/09536216.pdf

35. The ’025 Accused Products perform inverse-quantization to the post-quantization data to generate post-quantization orthogonal transform coefficients data and perform inverse-orthogonal transform to the post-quantization orthogonal transform coefficients data to produce a decoded residual picture of one video area.

36. The ’025 Accused Products define a boundary condition of a border that corresponds to the motion-vector data, from the reference picture based on the border motion-vector data and generate an estimated video signal in each rectangular zone in the picture to be coded, that satisfied Poisson’s Equation, thus producing a first predictive picture.

37. The ’025 Accused Products combine the first predictive picture and the decoded residual picture to generate a decoded moving-picture signal:



Source: https://wenxiaoming.github.io/2019/03/02/The-overview-of-AV1-coding/

7.14. Loop filter process

7.14.1. General

Input to this process is the array CurrFrame of reconstructed samples.

Output from this process is a modified array CurrFrame containing deblocked samples.

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, Page 307

38. The '025 Accused Products store the decoded moving-picture signal for at least one picture as a reference picture, by updating the set of reference frames.

39. Defendant has and continues to directly infringe at least claim 10 of the ’025 Patent by making, using, offering to sell, selling, and/or importing into the United States products that implement AV1 and/or SVT-AV1 standards, such as the ’025 Accused Products.

40. Defendant has been on actual notice of the ’025 Patent and Defendant’s infringement thereof at least as of February 24, 2012, when it was cited during prosecution of Defendant’s United States Provisional Patent Application No. 61/603,047, entitled “Pixel Patch Collection for Prediction in Video Coding System.”

41. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’025 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’025 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the ’025 Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the ’025 Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation. Because of Defendant’s inducement, Defendant’s customers and end-users use the ’025 Accused Products in a way Defendant intends and they directly infringe the ’025 Patent. Defendant performs these affirmative acts with knowledge of the ’025 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’025 Patent.

42. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’025 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement

by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the '025 Accused Products in this District and elsewhere in the United States and causing the '025 Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the Accused Products, such that the '025 Patent is directly infringed by others. The accused components within the Accused Products including, but not limited to, software manufactured by Defendant, are material to the invention of the '025 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '025 Patent. Defendant performs these affirmative acts with knowledge of the '025 Patent and with intent, or willful blindness, that they cause the direct infringement of the '025 Patent.

43. Defendant's infringement of the '025 Patent is and has been willful. Defendant was on notice of the existence of the '025 Patent and its infringement thereof or has been willfully blind as to the existence of the '025 Patent and its infringement thereof. As one example, Defendant is a founding member of the Alliance for Open Media, the organization that publishes the AV1 Specification. The Alliance for Open Media's stated goal was to create a video codec that was free of patent licensing obligations associated with prior video codecs. Defendant's preference would be that its products previously used a video codec called HEVC, and Defendant was motivated to avoid HEVC licensing fees by developing AV1 through the Alliance for Open Media. https://bitmovin.com/apple-joins-av1-codec-consortium. The Alliance for Open Media, including Defendant, conducted a "comprehensive evaluation of the video codec patent landscape and performance of patent due diligence by world-class codec engineers and legal professionals during the development stage." https://aomedia.org/press%20releases/the-alliance-for-open-media-

statement/. Upon information and belief, this "patent due diligence" either uncovered the existence of the '025 Patent and Defendant's infringement thereof, or should have uncovered the existence of the '025 Patent and Defendant's infringement thereof. Defendant could not have reasonably believed that the development of the AV1 video codec could not infringe any valid patent claims, including those of the '025 Patent.

44. Upon information and belief, Defendant had actual knowledge of the '025 Patent from related prior litigations accusing products with similar AV1 functionalities involving direct competitors of Defendant.

45. ACT has suffered damages as a result of Defendant's direct and indirect infringement of the '025 Patent in an amount to be proved at trial.

46. Defendant's direct and indirect infringement of the '025 Patent has been and continues to be willful, intentional, deliberate, and/or in conscious disregard of ACT's rights under the '025 Patent. ACT is entitled to an award of treble damages, reasonable attorney fees, and costs in bringing this action.

COUNT II
(Infringement of the '303 Patent)

47. Paragraphs 1 through 25 are incorporated by reference as if fully set forth herein.

48. ACT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '303 Patent.

49. Defendant has and continues to directly infringe the '303 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each and every limitation of one or more claims of the '303 Patent. Such products include at least all iPhones and iPads running iOS 15 or later (e.g., iPhone 15, iPhone Pro, iPad Pro (11-inch, M4,

2024), iPad Pro (13-inch, M4, 2024)), all Macs running macOS Big Sur or later (e.g., iMac (24-inch, 2023), MacBook Pro (14-inch, Nov 2023), MacBook Pro (16-inch, Nov 2023), MacBook Air (13-inch, M3, 2024), and MacBook Air (15-inch, M3, 2024)), and all Apple TVs running tvOS 14 or later, in addition to Apple software and services, such as Safari, QuickTime, and Apple TV+ (the '303 Accused Products) (https://www.coconut.co/articles/ultimate-guide-apples-av1-support-2023; https://bitmovin.com/av1-playback-support), which include a video image coding data receiver comprising a processor and a memory unit having instructions stored which, when executed by the processor, cause the processor to perform operations comprising receiving basic video image coding data; decoding the received basic video image coding data so as to reproduce a video image; receiving supplementary video image coding data including a supplementary hierarchical picture whose coding order and display order are earlier by a factor of a group of pictures including an intra coded picture and a plurality of inter prediction coded pictures than those of a basic hierarchical picture included in the basic video image coding data, a basic hierarchy and a supplementary hierarchy being set in units of the group of pictures; acquiring basic video image coding data received before supplementary video image coding data that has been received at the moment; and reconstructing video image coding data from the basic video image coding data and the supplementary video image coding data.

50. For example, Defendant has and continues to directly infringe at least claim 1 of the '303 Patent by making, using, offering to sell, selling, and/or importing into the United States iPhones, iPads, Macs, and Apple software and services, such as Safari, QuickTime, and Apple TV+, and chipsets thereof, that are compliant with the AV1 and/or SVT-AV1 Standards, such as the '303 Accused Products.

51. The ’303 Accused Products are video image coding data receivers that include a processor and a memory.

52. The ’303 Accused Products are configured to receive and decode basic video image coding data, such as a bitstream of video at 720p resolution, and to decode that data to reproduce a video image.

53. The ’303 Accused Products are configured to receive supplementary video image coding data including a supplementary hierarchical picture, such as a bitstream of video at a 1080p resolution.

54. The supplementary hierarchical picture’s coding order and display order are earlier than those of a basic hierarchical picture by a factor of a group of pictures. For example, AV1 uses an S frame to switch to lower or higher frame rates:

Switch Frame
An inter frame that can be used as a point to switch between sequences. Switch frames overwrite all the reference frames without forcing the use of intra coding. The intention is to allow a streaming use case where videos can be encoded in small chunks (say of 1 second duration), each starting with a switch frame. If the available bandwidth drops, the server can start sending chunks from a lower bitrate encoding instead. When this happens the inter prediction uses the existing higher quality reference frames to decode the switch frame. This approach allows a bitrate switch without the cost of a full key frame.

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, at Page 5

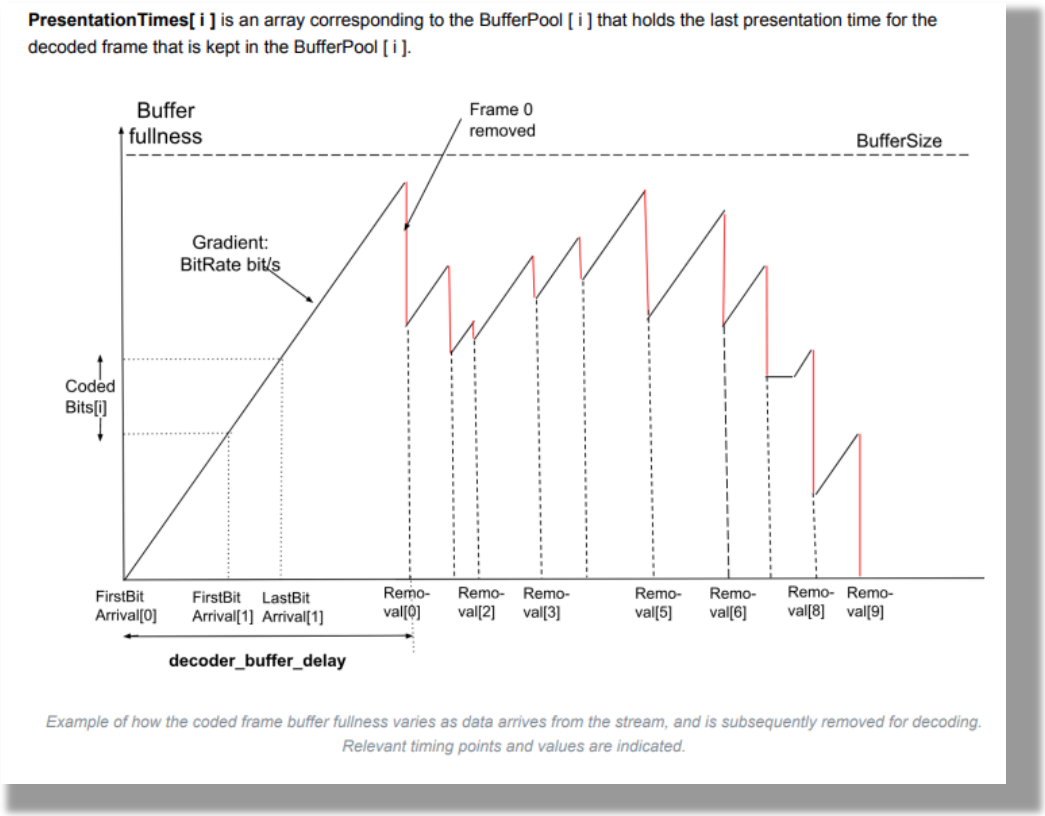
55. Each Group of Pictures includes an intra coded picture and a plurality of inter prediction coded pictures:

frame_type specifies the type of the frame:

frame_type	Name of frame_type
0	KEY_FRAME
1	INTER_FRAME
2	INTRA_ONLY_FRAME
3	SWITCH_FRAME

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, at Page 150

56. The supplementary hierarchical picture's coding order and display order are earlier than the basic hierarchical picture because the received data is stored in a buffer before decoding:

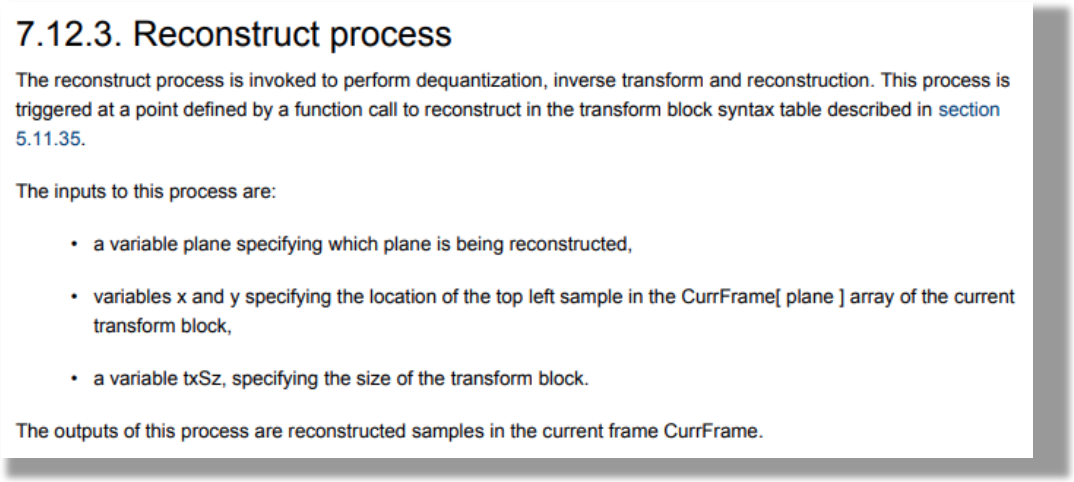


Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, at Pages 654-55

57. Therefore, when an S frame switches from basic to supplementary video data, basic hierarchical pictures are still decoded and displayed out of the buffer.

58. The '303 Accused Products are configured to acquire basic video image coding data from the buffer, which has been received before supplementary video image coding data that has been received at the moment of the switch in resolutions.

59. The '303 Accused Products reconstruct video image coding data from the basic video image coding data and the supplementary video image coding data:



7.12.3. Reconstruct process

The reconstruct process is invoked to perform dequantization, inverse transform and reconstruction. This process is triggered at a point defined by a function call to reconstruct in the transform block syntax table described in section 5.11.35.

The inputs to this process are:

- a variable plane specifying which plane is being reconstructed,
- variables x and y specifying the location of the top left sample in the CurrFrame[plane] array of the current transform block,
- a variable txSz, specifying the size of the transform block.

The outputs of this process are reconstructed samples in the current frame CurrFrame.

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, at Page 294

60. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’303 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’303 Patent. Defendant induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the ’303 Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the ’303 Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation. Because of Defendant e’s inducement, Defendant’s customers and end-users use the ’303 Accused Products in a way Defendant intends and they directly infringe the ’303 Patent. Defendant performs these affirmative acts with knowledge of the ’303 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’303 Patent.

61. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '303 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the '303 Accused Products in this District and elsewhere in the United States and causing the '303 Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the '303 Accused Products, such that the '303 Patent is directly infringed by others. The accused components within the '303 Accused Products including, but not limited to, software manufactured by Defendant, are material to the invention of the '303 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '303 Patent. Defendant performs these affirmative acts with knowledge of the '303 Patent and with intent, or willful blindness, that they cause the direct infringement of the '303 Patent.

62. Defendant's infringement of the '303 Patent is and has been willful. Defendant was on notice of the existence of the '303 Patent and its infringement thereof, or has been willfully blind as to the existence of the '303 Patent and its infringement thereof. As one example, Defendant is a founding member of the Alliance for Open Media, the organization that publishes the AV1 Specification. The Alliance for Open Media's stated goal was to create a video codec that was free of patent licensing obligations associated with prior video codecs. Defendant's preference would be that its products previously used a video codec called HEVC, and Defendant was motivated to avoid HEVC licensing fees by developing AV1 through the Alliance for Open Media. https://bitmovin.com/apple-joins-av1-codec-consortium. The Alliance for Open Media, including Defendant, conducted a "comprehensive evaluation of the video codec patent landscape and

performance of patent due diligence by world-class codec engineers and legal professionals during the development stage." https://aomedia.org/press%20releases/the-alliance-for-open-media-statement/. Upon information and belief, this "patent due diligence" either uncovered the existence of the '303 Patent and Defendant's infringement thereof, or should have uncovered the existence of the '303 Patent and Defendant's infringement thereof. Defendant could not have reasonably believed that the development of the AV1 video codec could not infringe any valid patent claims, including those of the '303 Patent.

63. Upon information and belief, Defendant had actual knowledge of the '303 Patent from related prior litigations accusing products with similar AV1 functionalities involving direct competitors of Defendant.

64. ACT has suffered damages as a result of Defendant's direct and indirect infringement of the '303 Patent in an amount to be proved at trial.

65. Defendant's direct and indirect infringement of the '303 Patent has been and continues to be willful, intentional, deliberate, and/or in conscious disregard of ACT's rights under the '303 Patent. ACT is entitled to an award of treble damages, reasonable attorney fees, and costs in bringing this action.

COUNT III
(Infringement of the '995 Patent)

66. Paragraphs 1 through 25 are incorporated by reference as if fully set forth herein.

67. ACT has not licensed or otherwise authorized Defendant to make, use, offer for sale, sell, or import any products that embody the inventions of the '995 Patent.

68. Defendant has and continues to directly infringe the '995 Patent, either literally or under the doctrine of equivalents, without authority and in violation of 35 U.S.C. § 271, by making, using, offering to sell, selling, and/or importing into the United States products that satisfy each

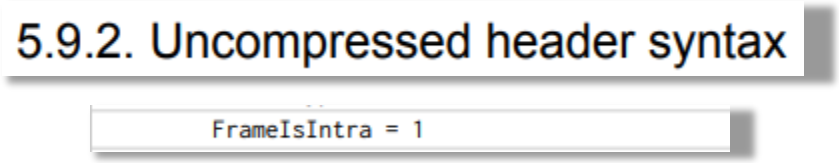
and every limitation of one or more claims of the ’995 Patent. Such products include at least all iPhones and iPads running iOS 15 or later (e.g., iPhone 15, iPhone Pro, iPad Pro (11-inch, M4, 2024), iPad Pro (13-inch, M4, 2024)), all Macs running macOS Big Sur or later (e.g., iMac (24-inch, 2023), MacBook Pro (14-inch, Nov 2023), MacBook Pro (16-inch, Nov 2023), MacBook Air (13-inch, M3, 2024), and MacBook Air (15-inch, M3, 2024)), and all Apple TVs running tvOS 14 or later, in addition to Apple software and services, such as Safari, QuickTime, and Apple TV+ (the ’995 Accused Products) (https://www.coconut.co/articles/ultimate-guide-apples-av1-support-2023; https://bitmovin.com/av1-playback-support), which include a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits; a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with a standard resolution; a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with a standard resolution at the first decoder to work on the sequence of decoded pictures to implement an interpolation of pixels with a first enlargement to create a sequence of super-resolution enlarged decoded pictures with a first resolution higher than a standard resolution; a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to work on the sequence of super-resolution enlarged decoded pictures to implement a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with a standard resolution; a second decoder configured to acquire the second sequence of encoded bits obtained with a standard resolution at the demultiplexer as a set of decoding targets, the sequence of decoded pictures created with the standard resolution at the first decoder as a set of first reference pictures,

and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter as a set of second reference pictures, and select one of the set of first reference pictures and the set of second reference pictures based on reference picture selection information to implement a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution based on the set of decoding targets and the set of selected reference pictures; and a second resolution converter configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder to work on the sequence of decoded pictures to implement an interpolation of pixels with the second enlargement to create a sequence of enlarged decoded pictures with a high resolution as a second resolution higher than the standard resolution, wherein the set of decoding targets, the set of first reference pictures, and the set of second reference pictures have the same value in spatial resolution.

69. For example, Defendant has and continues to directly infringe at least claim 2 of the ’995 Patent by making, using, offering to sell, selling, and/or importing into the United States iPhones, iPads, Macs, and Apple software and services, such as Safari, QuickTime, and Apple TV+, and chipsets thereof, that are compliant with the AV1 and/or SVT-AV1 Standards, such as the ’995 Accused Products.

70. The ’995 Accused Products include a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits. AV1 and/or SVT-AV1 consist of a pipeline with either super-resolution being active or inactive for each frame. The demultiplexer generates

two sequences of bits, the first sequence of bits being the I-Frames sent to a first decoder, and the second sequence of bits being P-Frames sent to a second decoder:



Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, Pages 37-38

71. The '995 Accused Products include a first decoder configured to acquire the first sequence of encoded bits and decodes the I-Frames received from the demultiplexer.

72. The '995 Accused Products include a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with a standard resolution at the first decoder. With super-resolution active, after the normal decoding process is completed, the decoded I-Frames (*i.e.*, sequence of decoded pictures created with a standard resolution at the first decoder) are further sent to the deblocking, CDEF, upscale, and loop restoration block, where the decoded pictures are enlarged and upscaled to the original resolution *(i.e.*, higher than the standard resolution). In AV1 and/or SVT-AV1, the upscaling and loop restoration operations are referred to as the super-resolve steps (*i.e.*, the first super-resolution enlarger):

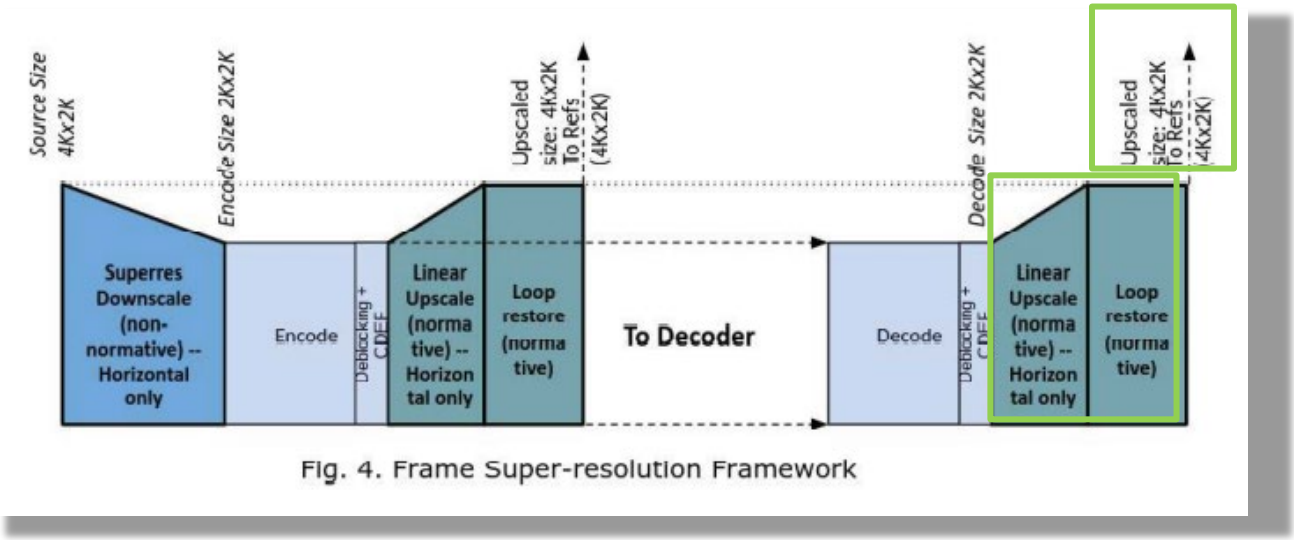


Fig. 4. Frame Super-resolution Framework

Source: https://sci-hub.se/https://ieeexplore.ieee.org/document/8954553

7.16. Upscaling process

Input to this process is an array inputFrame of width FrameWidth and height FrameHeight.

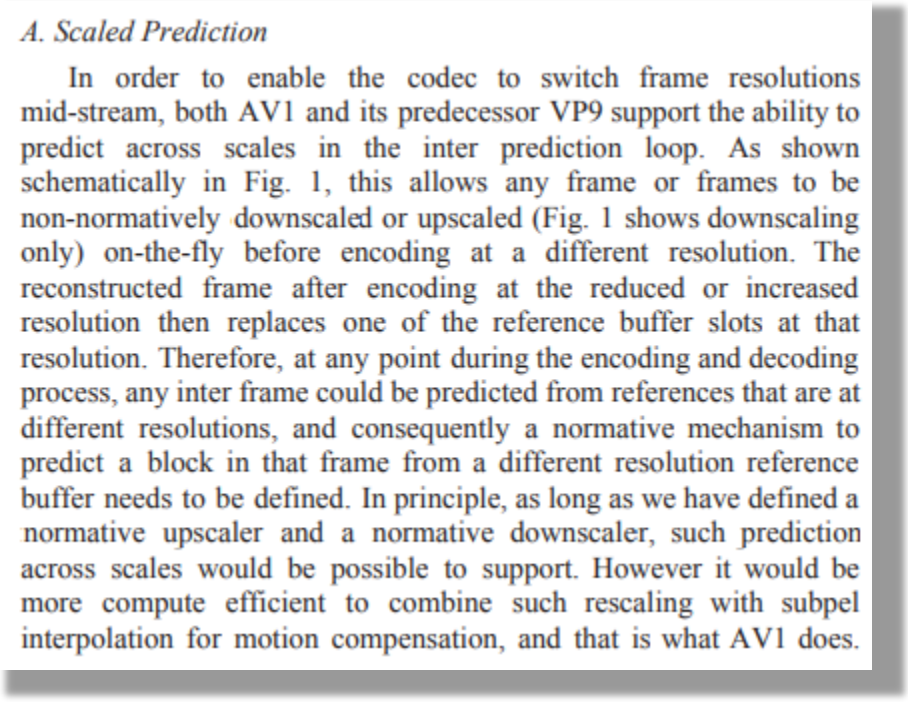
The output of this process is a horizontally upscaled frame of width UpscaledWidth and height FrameHeight.

If use_superres is equal to 0, no upscaling is required and this process returns inputFrame.

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, Page 325

73. The '995 Accused Products include a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to work on the sequence of super-resolution enlarged decoded pictures to implement a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with a standard resolution. After the loop restoration process, the reconstructed I-Frames are added to the reference buffer list which are further used for decoding of P-Frames. The reference pictures at the decoding side are scaled according to the resolution of current P-Frame which is to be decoded. Since the first super-resolution enlarger provides an upscaled

decoded reference pictures, the reference pictures are downscaled to match current P-Frame's resolution (frame being decoded by 2nd decoder) to be used as reference picture:



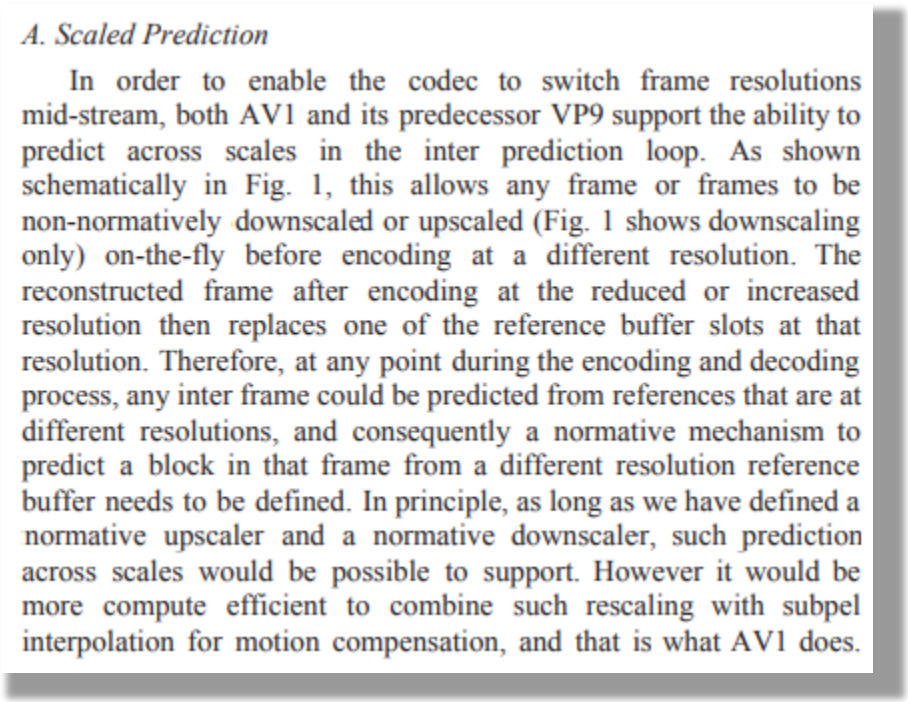
A. Scaled Prediction

In order to enable the codec to switch frame resolutions mid-stream, both AV1 and its predecessor VP9 support the ability to predict across scales in the inter prediction loop. As shown schematically in Fig. 1, this allows any frame or frames to be non-normatively downscaled or upscaled (Fig. 1 shows downscaling only) on-the-fly before encoding at a different resolution. The reconstructed frame after encoding at the reduced or increased resolution then replaces one of the reference buffer slots at that resolution. Therefore, at any point during the encoding and decoding process, any inter frame could be predicted from references that are at different resolutions, and consequently a normative mechanism to predict a block in that frame from a different resolution reference buffer needs to be defined. In principle, as long as we have defined a normative upscaler and a normative downscaler, such prediction across scales would be possible to support. However it would be more compute efficient to combine such rescaling with subpel interpolation for motion compensation, and that is what AV1 does.

Source: https://sci-hub.se/https://ieeexplore.ieee.org/document/8954553

74. The '995 Accused Products include a second decoder configured to acquire the second sequence of encoded bits obtained with a standard resolution at the demultiplexer as a set of decoding targets, the sequence of decoded pictures created with the standard resolution at the first decoder as a set of first reference pictures, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter as a set of second reference pictures, and select one of the set of first reference pictures and the set of second reference pictures based on reference picture selection information to implement a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution based on the set of decoding targets and the set of selected reference

pictures. The second decoder decodes the P-Frames. When frames are decoded without super-resolution being active and being used as reference frames, the reconstructed frames are used for inter-prediction of the current frame. When super-resolution is active, AV1 and/or SVT-AV1 produce decoded frames which are references that are super-resolved and then downscaled to match the current frame resolution. The second decoder waits for the current P-Frame to be decoded as received from the demultiplexer, and when it is received, the frame can be decoded based on the relevant reference I-Frame, whether super-resolved or non-super-resolved:



A. Scaled Prediction

In order to enable the codec to switch frame resolutions mid-stream, both AV1 and its predecessor VP9 support the ability to predict across scales in the inter prediction loop. As shown schematically in Fig. 1, this allows any frame or frames to be non-normatively downscaled or upscaled (Fig. 1 shows downscaling only) on-the-fly before encoding at a different resolution. The reconstructed frame after encoding at the reduced or increased resolution then replaces one of the reference buffer slots at that resolution. Therefore, at any point during the encoding and decoding process, any inter frame could be predicted from references that are at different resolutions, and consequently a normative mechanism to predict a block in that frame from a different resolution reference buffer needs to be defined. In principle, as long as we have defined a normative upscaler and a normative downscaler, such prediction across scales would be possible to support. However it would be more compute efficient to combine such rescaling with subpel interpolation for motion compensation, and that is what AV1 does.

Source: https://sci-hub.se/https://ieeexplore.ieee.org/document/8954553

75. Since AV1 and/or SVT-AV1 allow each frame to either be normally decoded or decoded with super-resolve steps, the reference picture buffer set consists of both non-super-resolved and super-resolved reference pictures (reconstructed frames). For the second decoder to decode the current frame, the reference frame is selected based on the reference index. The reference index, which indicates whether a super-resolved or non-super-resolved reconstructed

frame is selected, is the reference picture selection information that is sent in the encoded bitstream.

ref_frame_idx[i] specifies which reference frames are used by inter frames. It is a requirement of bitstream conformance that RefValid[ref_frame_idx[i]] is equal to 1, and that the selected reference frames match the current frame in bit depth, profile, chroma subsampling, and color space.

Note: Syntax elements indicate a reference (such as LAST_FRAME, ALTREF_FRAME). These references are looked up in the ref_frame_idx array to find which reference frame should be used during inter prediction. There is no requirement that the values in ref_frame_idx should be distinct.

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, 327

76. The ’995 Accused Products include a second resolution converter configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder to work on the sequence of decoded pictures to implement an interpolation of pixels with the second enlargement to create a sequence of enlarged decoded pictures with a high resolution as a second resolution higher than the standard resolution, wherein the set of decoding targets, the set of first reference pictures, and the set of second reference pictures have the same value in spatial resolution. In AV1 and/or SVT-AV1, the output of the 1st decoder (when super-resolution is not active), the decoded frames (reconstructed references) can also be upscaled. AV1 and/or SVT-AV1 use different 8-tap filter coefficient that can be used for upscaling of the decoded frame.

```
const int16_t av1_resize_filter_normative[(
    1 << RS_SUBPEL_BITS)][UPSCALE_NORMATIVE_TAPS] = {
#if UPSCALE_NORMATIVE_TAPS == 8
  { 0, 0, 0, 128, 0, 0, 0, 0 },        { 0, 0, -1, 128, 2, -1, 0, 0 },
  { 0, 1, -3, 127, 4, -2, 1, 0 },      { 0, 1, -4, 127, 6, -3, 1, 0 },
  { 0, 2, -6, 126, 8, -3, 1, 0 },      { 0, 2, -7, 125, 11, -4, 1, 0 },
  { -1, 2, -8, 125, 13, -5, 2, 0 },    { -1, 3, -9, 124, 15, -6, 2, 0 },
```

Source: https://aomedia.Applesource.com/aom/+/refs/heads/main/av1/common/resize.com

77. After the reference pictures are selected from the first and second set of reference picture, the reference pictures are upscaled or downscaled to match to resolution of the encoding targets:

Fig. 2 shows a scenario where a 4x4 block from the source needs to be predicted from a different resolution reference buffer. The motion vectors transmitted in the bitstream are always at the source resolution. So they are first scaled up or down based on the resolution ratio between the reference and source, and the corresponding source block pixels projected on the reference grid can then be obtained, as shown on the right of Fig. 2. Note that the relative sub-pixel positions horizontally (vertically) on the reference grid are the same in each row (column). Hence, the interpolation for scaled prediction can be implemented simply as separable filtering in each dimension using a suitable starting sub-pixel offset and a sub-pixel step between pixels.

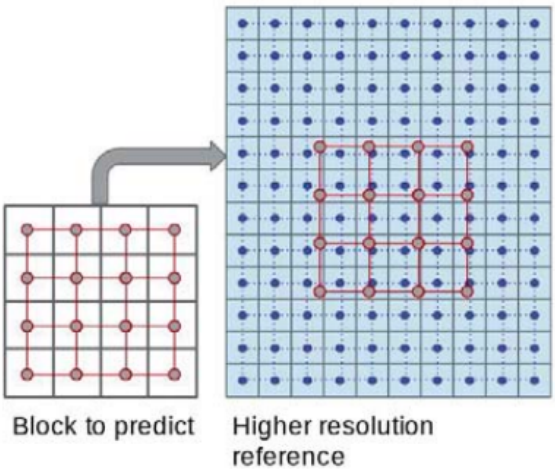


Fig. 2. Predicting a block from different (higher shown) resolution reference

Source: https://sci-hub.se/https://ieeexplore.ieee.org/document/8954553, Page 2

78. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the ’995 Patent, as provided by 35 U.S.C. § 271(b), by inducing infringement by others, such as Defendant’s customers and end-users, in this District and elsewhere in the United States. For example, Defendant’s customers and end-users directly infringe, either literally or under the doctrine of equivalents, through their use of the inventions claimed in the ’995 Patent. Defendant

induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the '995 Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting that they use the '995 Accused Products in an infringing manner, including technical support, marketing, product manuals, advertisements, and online documentation. Because of Defendant's inducement, Defendant's customers and end-users use the '995 Accused Products in a way Defendant intends and they directly infringe the '995 Patent. Defendant performs these affirmative acts with knowledge of the '995 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '995 Patent.

79. Defendant has indirectly infringed and continues to indirectly infringe one or more claims of the '995 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement by others, such as customers and end-users, in this District and elsewhere in the United States. Defendant's affirmative acts of selling and offering to sell the '995 Accused Products in this District and elsewhere in the United States and causing the '995 Accused Products to be manufactured, used, sold, and offered for sale contribute to others' use and manufacture of the '995 Accused Products such that the '995 Patent is directly infringed by others. The accused components within the '995 Accused Products including, but not limited to, software manufactured by Defendant, are material to the invention of the '995 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Defendant to be especially made or adapted for use in the infringement of the '995 Patent. Defendant performs these affirmative acts with knowledge of the '995 Patent and with intent, or willful blindness, that they cause the direct infringement of the '995 Patent.

80. Defendant's infringement of the '995 Patent is and has been willful. Defendant was on notice of the existence of the '995 Patent and its infringement thereof, or has been willfully blind as to the existence of the '995 Patent and its infringement thereof. As one example, Defendant is a founding member of the Alliance for Open Media, the organization that publishes the AV1 Specification. The Alliance for Open Media's stated goal was to create a video codec that was free of patent licensing obligations associated with prior video codecs. Defendant's preference would be that its products previously used a video codec called HEVC, and Defendant was motivated to avoid HEVC licensing fees by developing AV1 through the Alliance for Open Media. https://bitmovin.com/apple-joins-av1-codec-consortium. The Alliance for Open Media, including Defendant, conducted a "comprehensive evaluation of the video codec patent landscape and performance of patent due diligence by world-class codec engineers and legal professionals during the development stage." https://aomedia.org/press%20releases/the-alliance-for-open-media-statement/. Upon information and belief, this "patent due diligence" either uncovered the existence of the '995 Patent and Defendant's infringement thereof, or should have uncovered the existence of the '995 Patent and Defendant's infringement thereof. Defendant could not have reasonably believed that the development of the AV1 video codec could not infringe any valid patent claims, including those of the '995 Patent.

81. Upon information and belief, Defendant had actual knowledge of the '995 Patent from related prior litigations accusing products with similar AV1 functionalities involving direct competitors of Defendant.

82. ACT has suffered damages as a result of Defendant's direct and indirect infringement of the '995 Patent in an amount to be proved at trial.

83. Defendant's direct and indirect infringement of the '995 Patent has been and continues to be willful, intentional, deliberate, and/or in conscious disregard of ACT's rights under the '995 Patent. ACT is entitled to an award of treble damages, reasonable attorney fees, and costs in bringing this action.

DEMAND FOR JURY TRIAL

Plaintiff hereby demands a jury for all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, ACT prays for relief against Defendant as follows:

a. Entry of judgment declaring that Defendant has directly and/or indirectly infringed one or more claims of each of the Patents-in-Suit;

b. An order pursuant to 35 U.S.C. § 283 permanently enjoining Defendant, its officers, agents, servants, employees, attorneys, and those persons in active concert or participation with them, from further acts of infringement of the Patents-in-Suit;

c. An order awarding damages sufficient to compensate ACT for Defendant's infringement of the Patents-in-Suit, but in no event less than a reasonable royalty, together with interest and costs;

d. Entry of judgment declaring that Defendant's infringement has been willful and awarding ACT treble damages pursuant to 35 U.S.C. § 284; and

e. Entry of judgment declaring that this case is exceptional and awarding ACT its costs and reasonable attorney fees under 35 U.S.C. § 285; and

f. Such other and further relief as the Court deems just and proper.

Dated: July 22, 2024

Respectfully submitted,

/s/ Peter Lambrianakos

Alfred R. Fabricant
NY Bar No. 2219392
Email: ffabricant@fabricantllp.com
Peter Lambrianakos
NY Bar No. 2894392
Email: plambrianakos@fabricantllp.com
Vincent J. Rubino, III
NY Bar No. 4557435
Email: vrubino@fabricantllp.com
Joseph M. Mercadante
NY Bar No. 4784930
Email: jmercadante@fabricantllp.com
FABRICANT LLP
411 Theodore Fremd Avenue, Suite 206 South
Rye, New York 10580
Telephone: (212) 257-5797
Facsimile: (212) 257-5796

ATTORNEYS FOR PLAINTIFF
ADVANCED CODING TECHNOLOGIES, LLC